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Optimal Investment Paths for the Danish Energy System in the CEEH Modelling System

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Optimal Investment Paths for the Danish Energy System in the CEEH Modelling System

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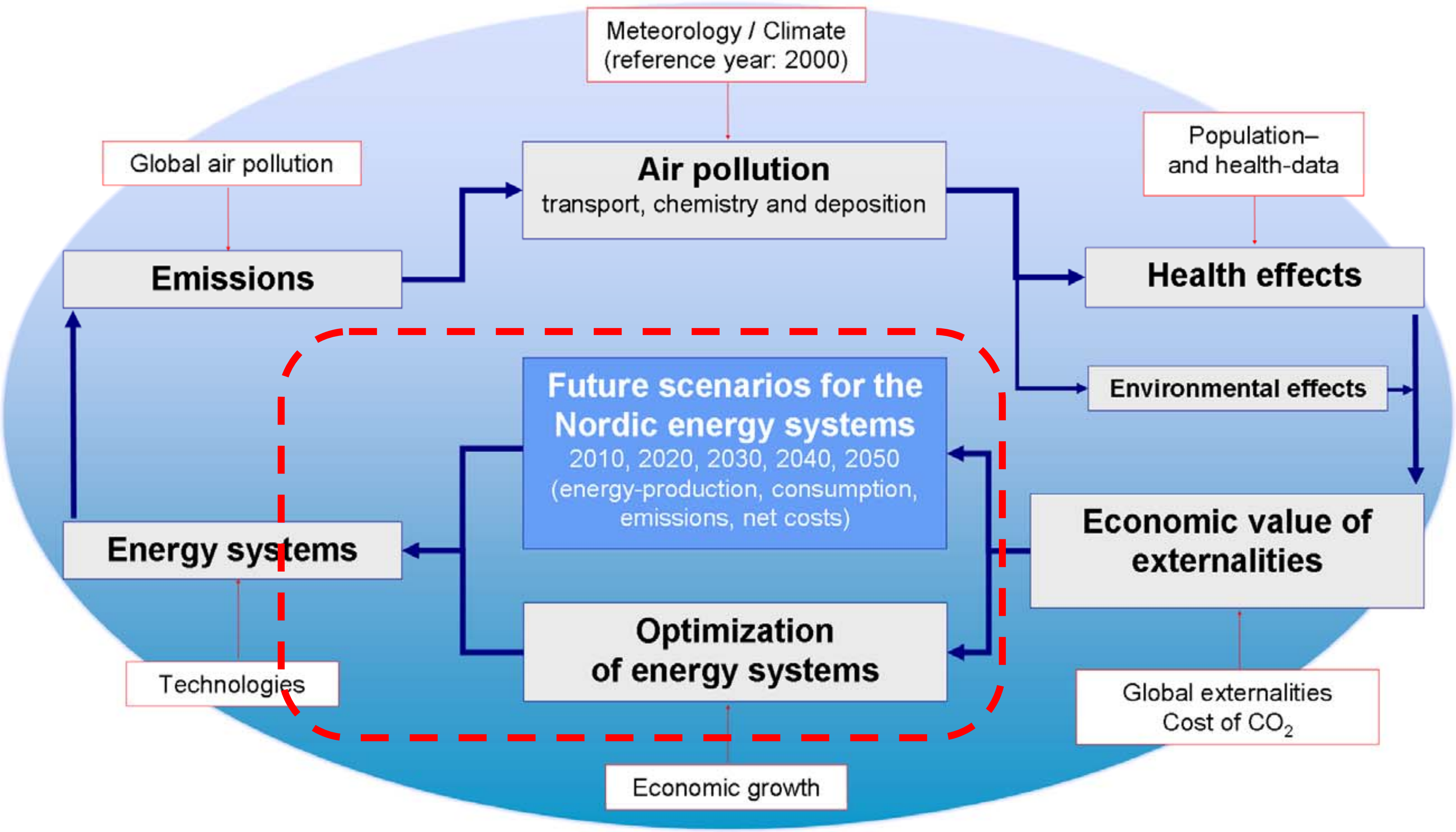
Copenhagen, Denmark

Risø DTU
National Laboratory for Sustainable Energy

CEEH Modelling Framework

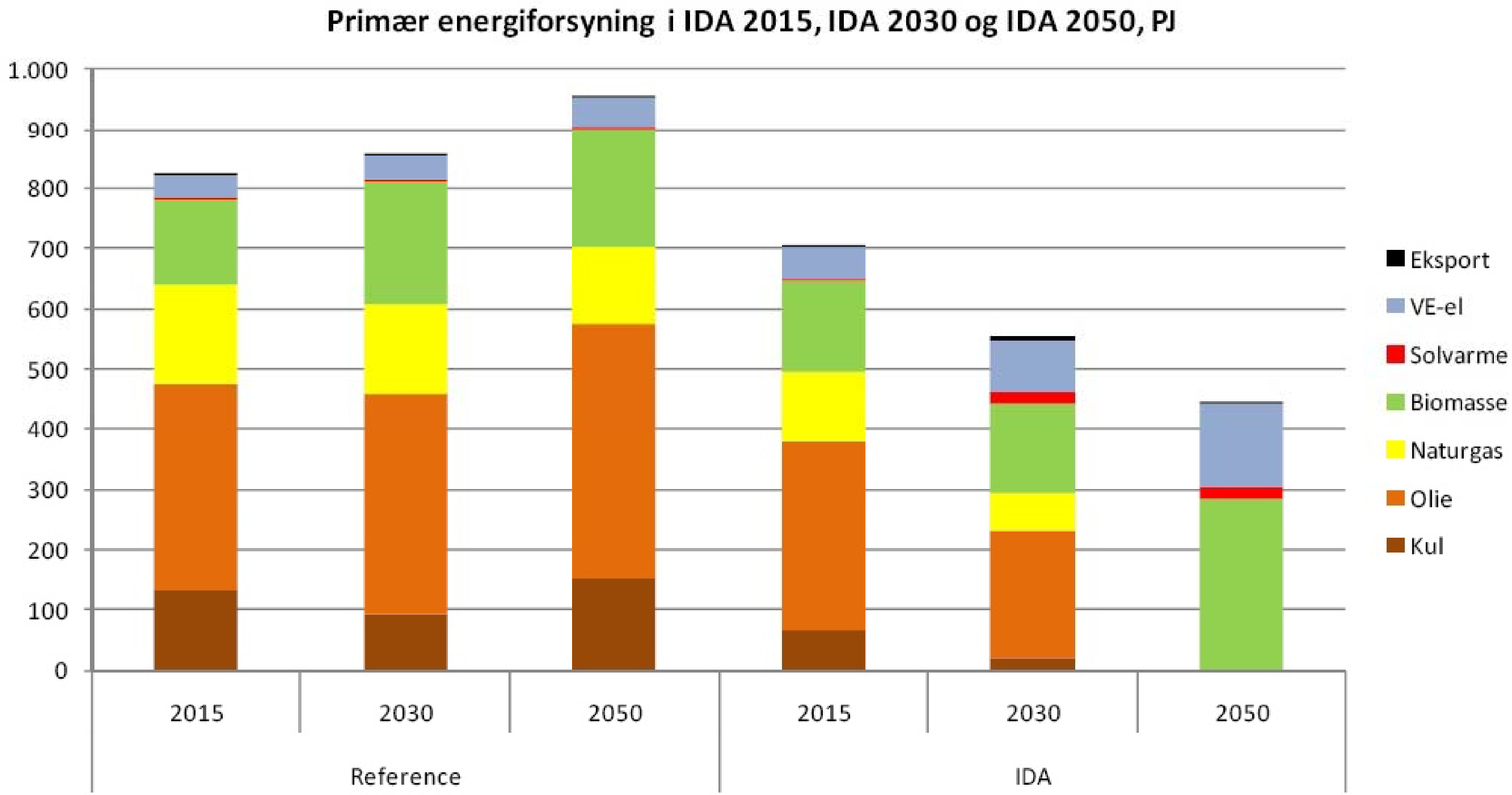


Input to the CEEH Machine and output

- Economic development
- Demographics
- Global emission data
- Meteorology
- Technology data
- Fuel costs
- External environmental costs

- Health costs from energy conversion
- External health cost for each emission spices (€/kg)
- “Optimal” investment patterns for the Scandinavian energy system – with focus on Denmark
- Fuel use and emission from the energy system

Use of CEEH results in IDA2050 plan – www.ida.dk



Use of CEEH results in IDA2050 plan – www.ida.dk

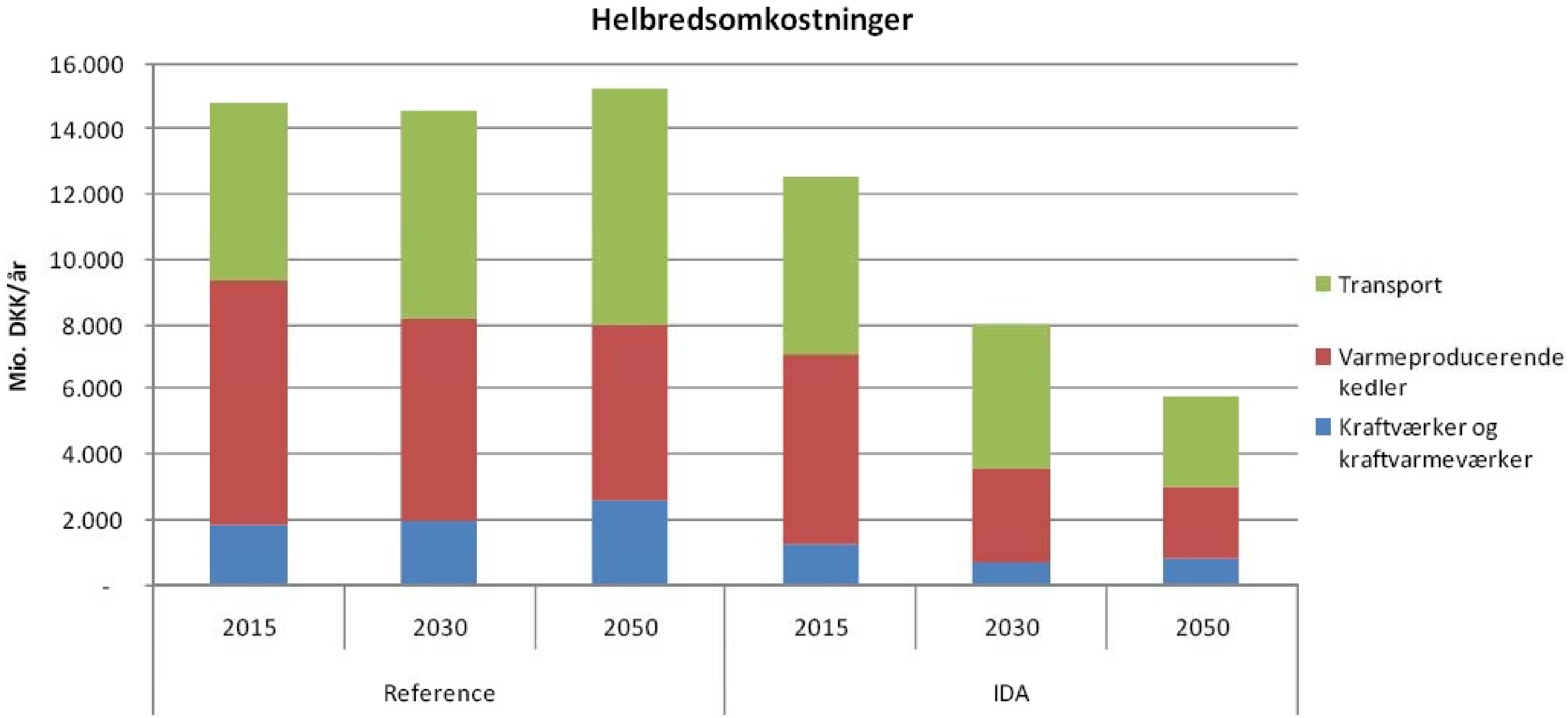
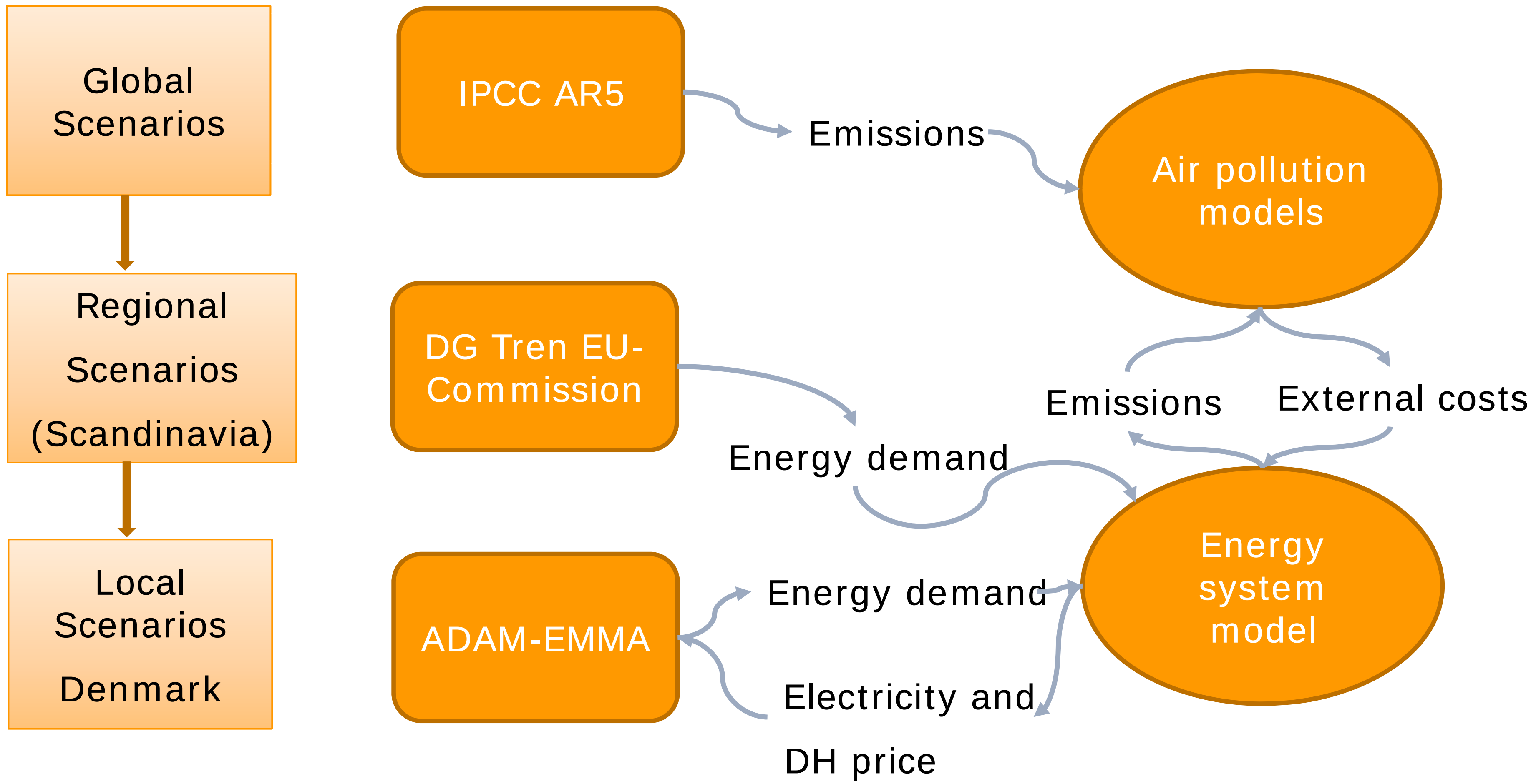


Fig. 31, Samlede helbredsomkostninger for energisystemerne fordelt på sektorer.

Scenarios at different levels



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Electricity & DH prices

ADAM-EMMA

Macro economic projections

Energy services

End-use energy

Industry

Service

Households

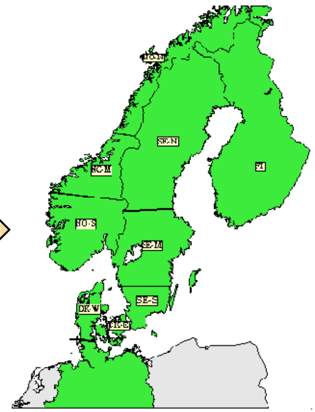
Transport

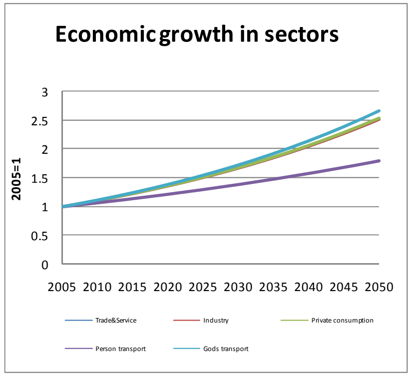
Electricity

Heat demand

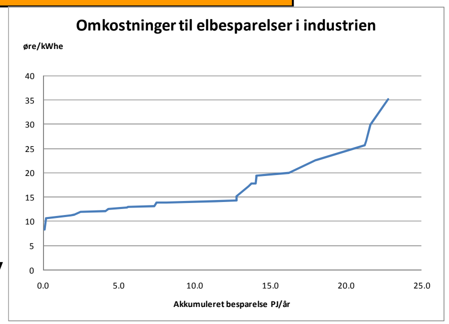
Transport fuels

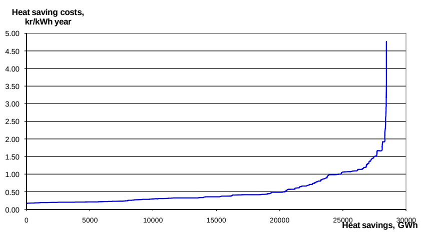
Balmorel





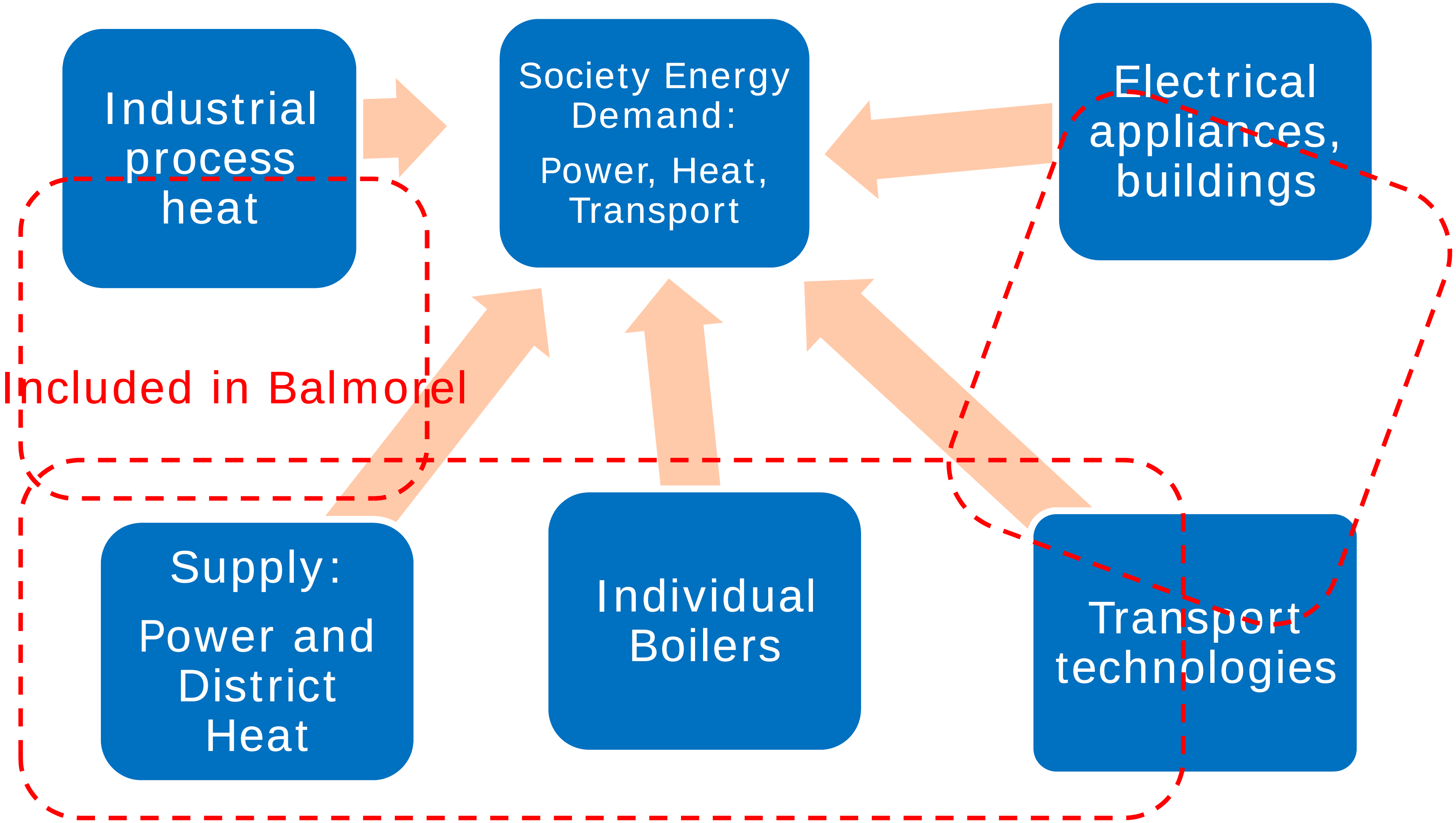
Efficiency improvements





Air emissions : CO_2, SO_2, NO_x, pm, CO

Energy System



Example of results from Balmorel

The impact of including health costs

- Comparing two scenarios with identical inputs except from the inclusion of heath costs

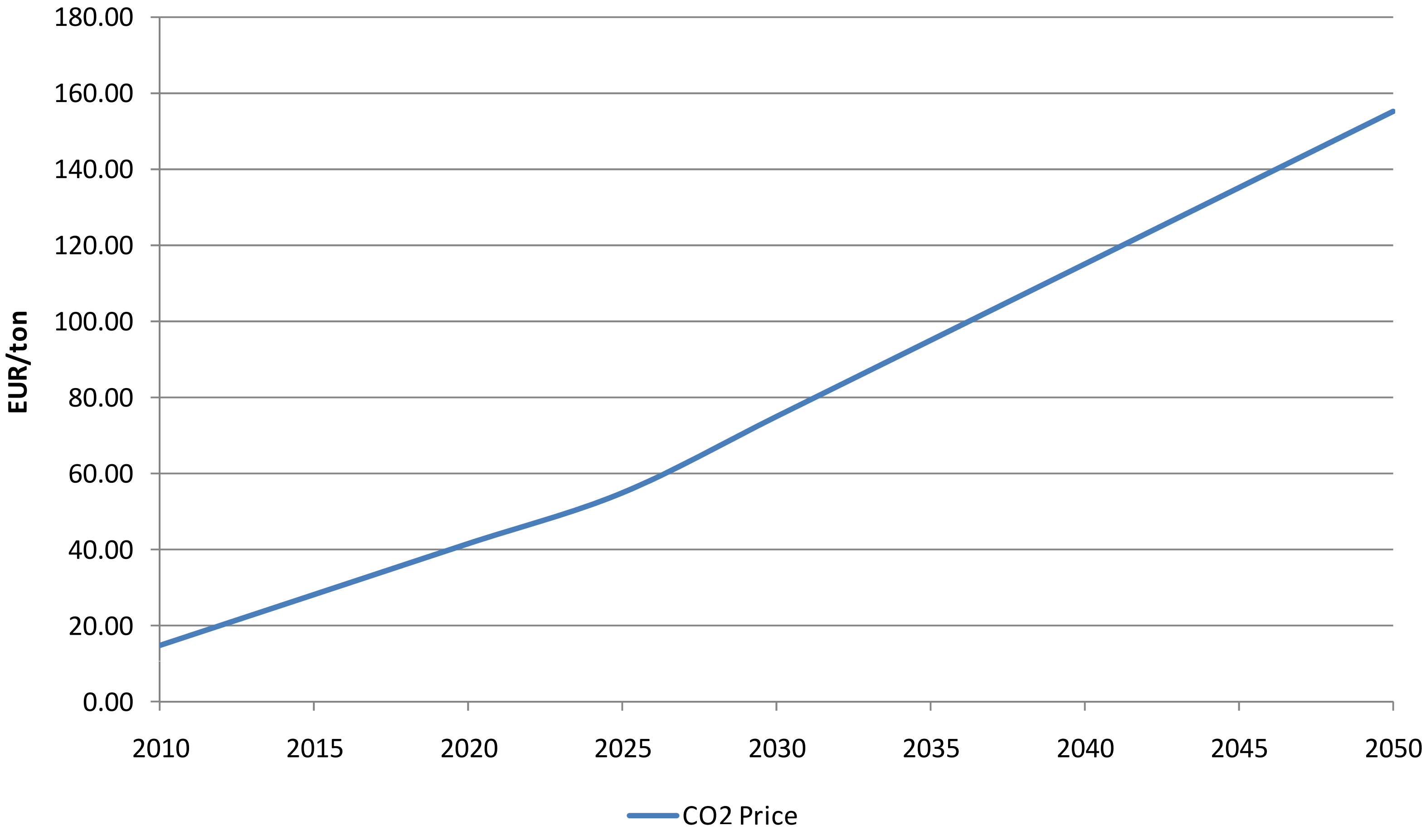
Policy-free scenarios

- "Base"-scenario includes health costs and
- "No-Health" do not include health costs

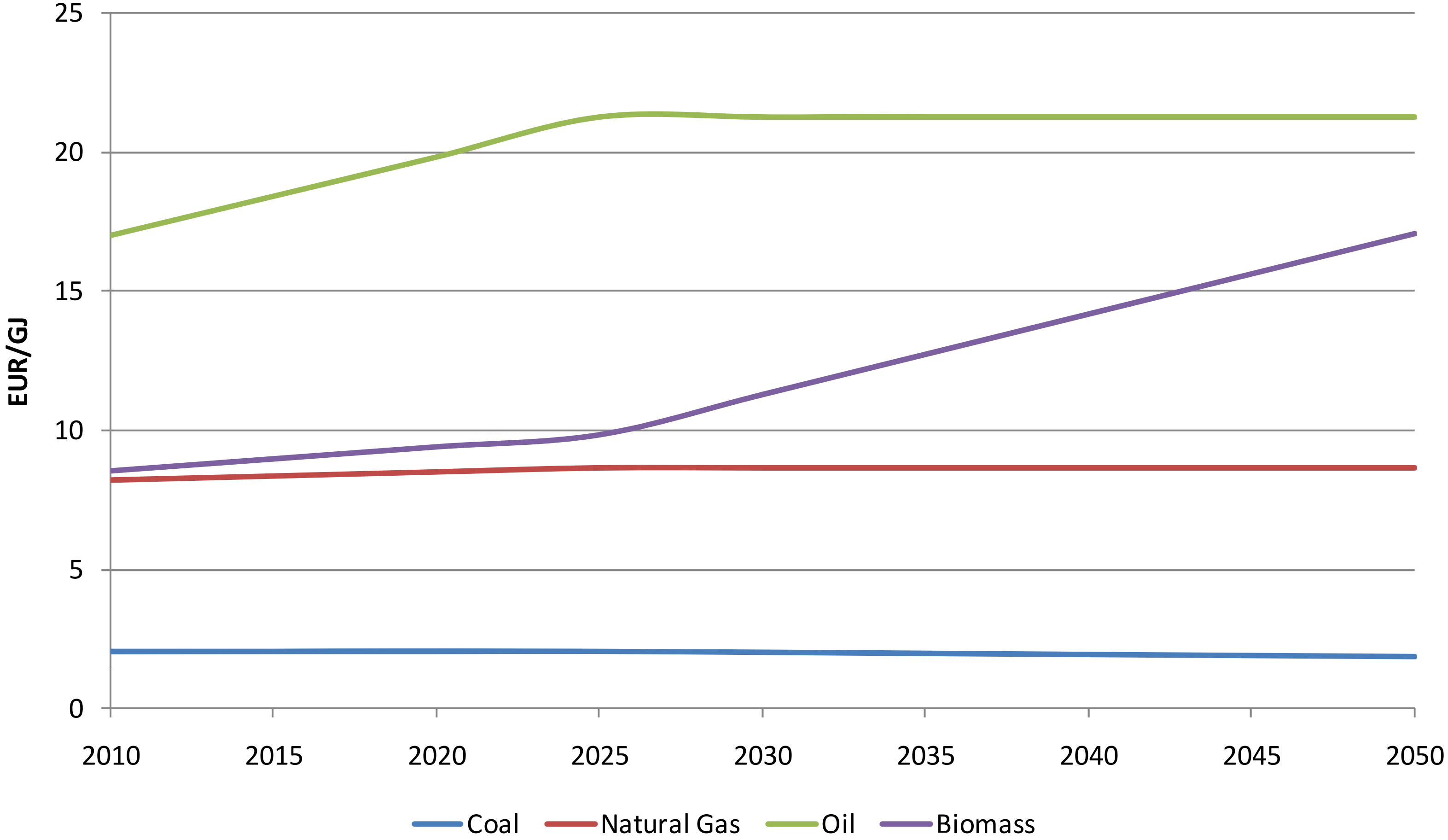
A full year in the simulation is currently represented by four weeks

The results are preliminary and still needs further investigation and interpretation !

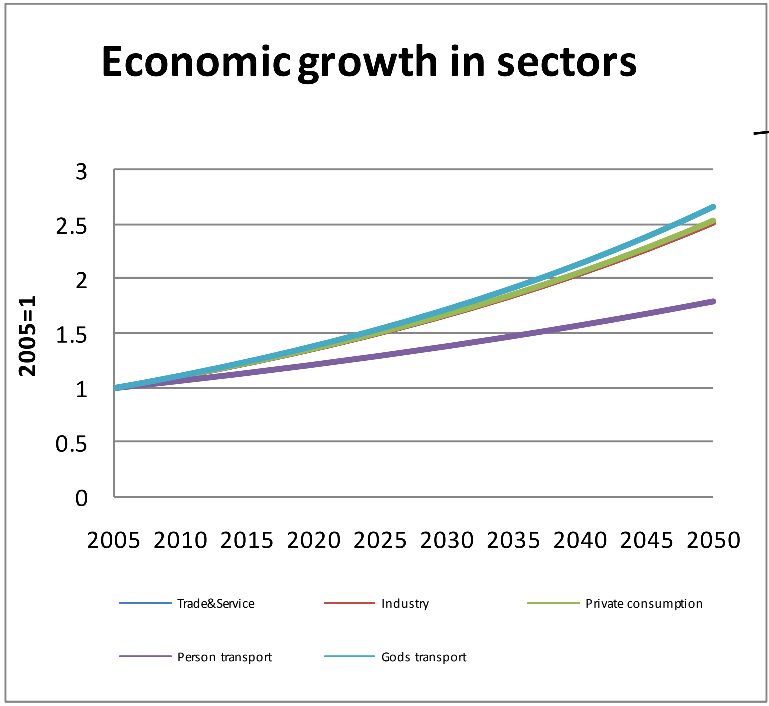
Assumptions I: CO2 Price Development



Assumptions II: Fuel Price Development



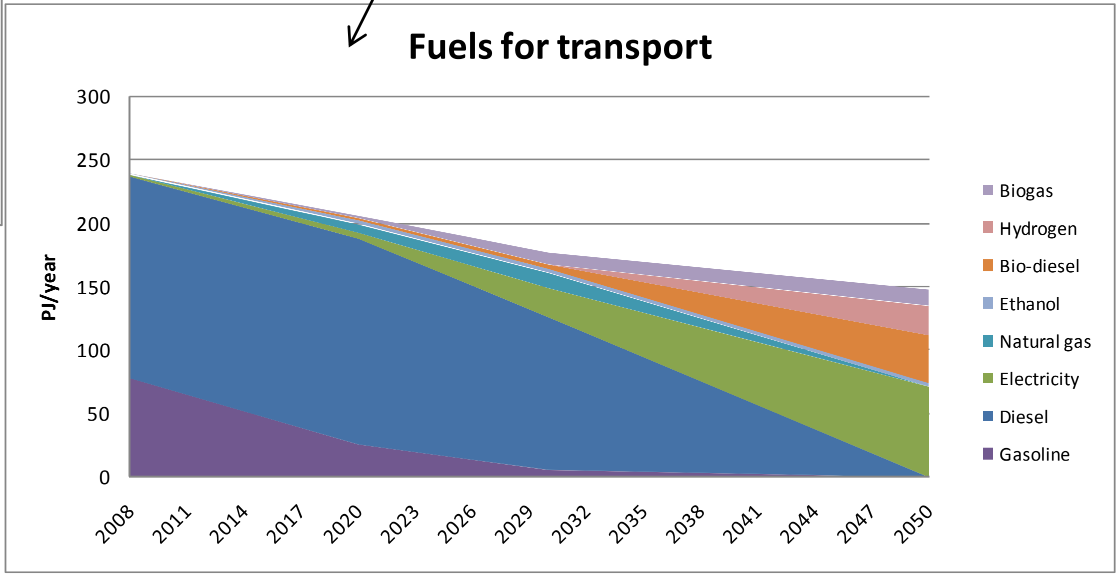
Demand inputs



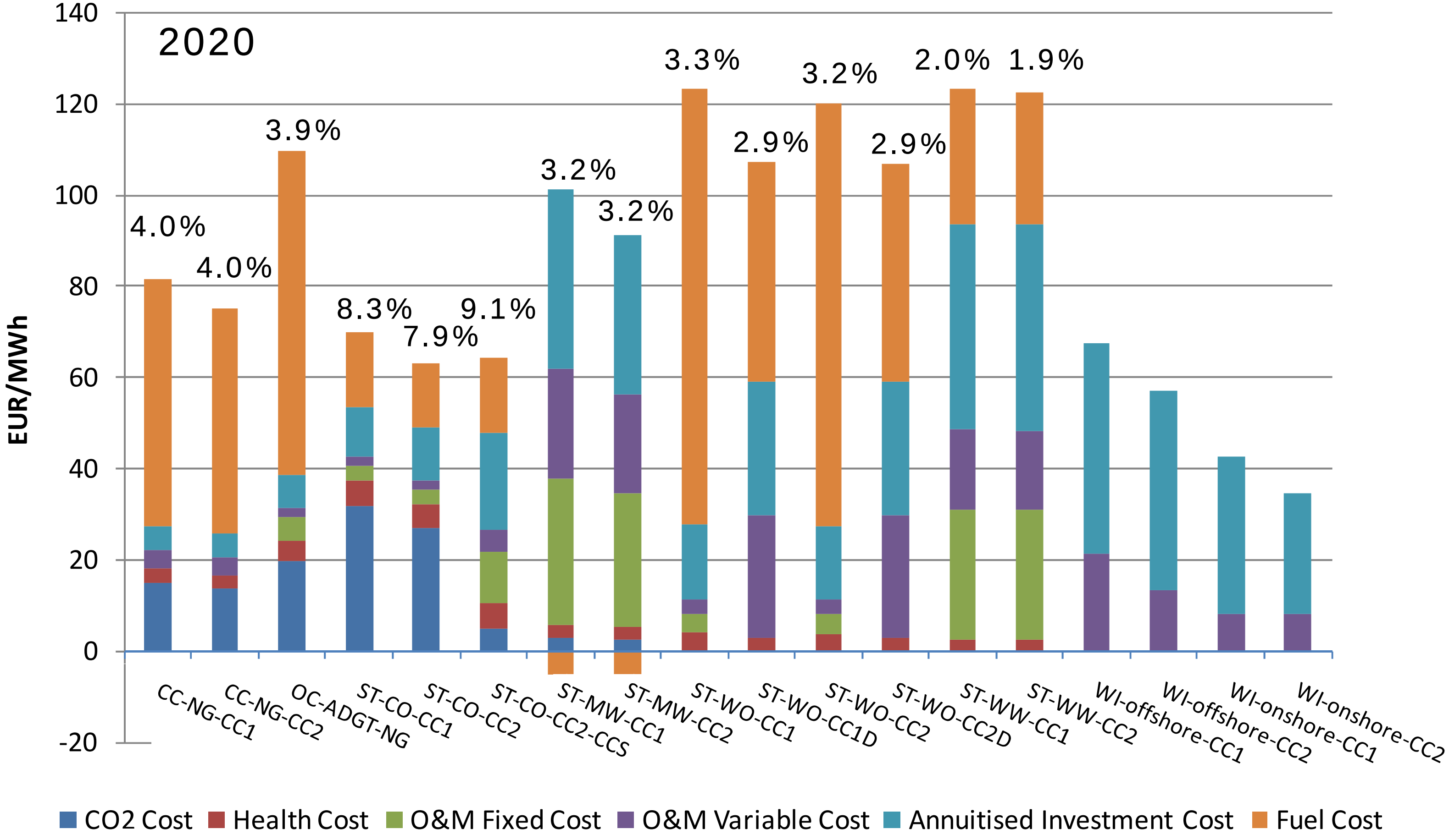
Electricity and heat demand in Denmark, Norway, Sweden, Finland and Germany

Include electricity savings in the input, but not heat savings.

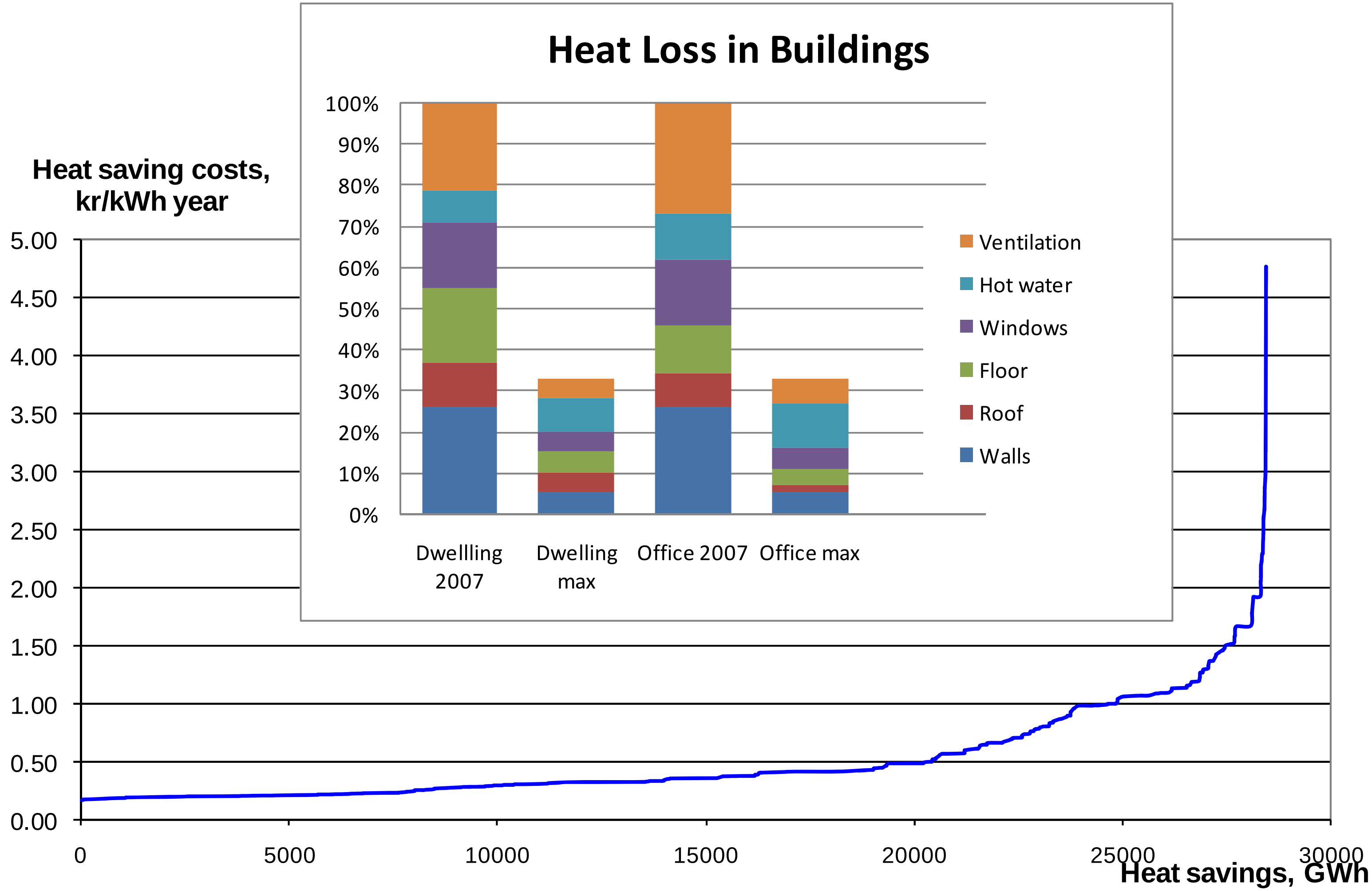
The transport fuel scenario is created exogenous



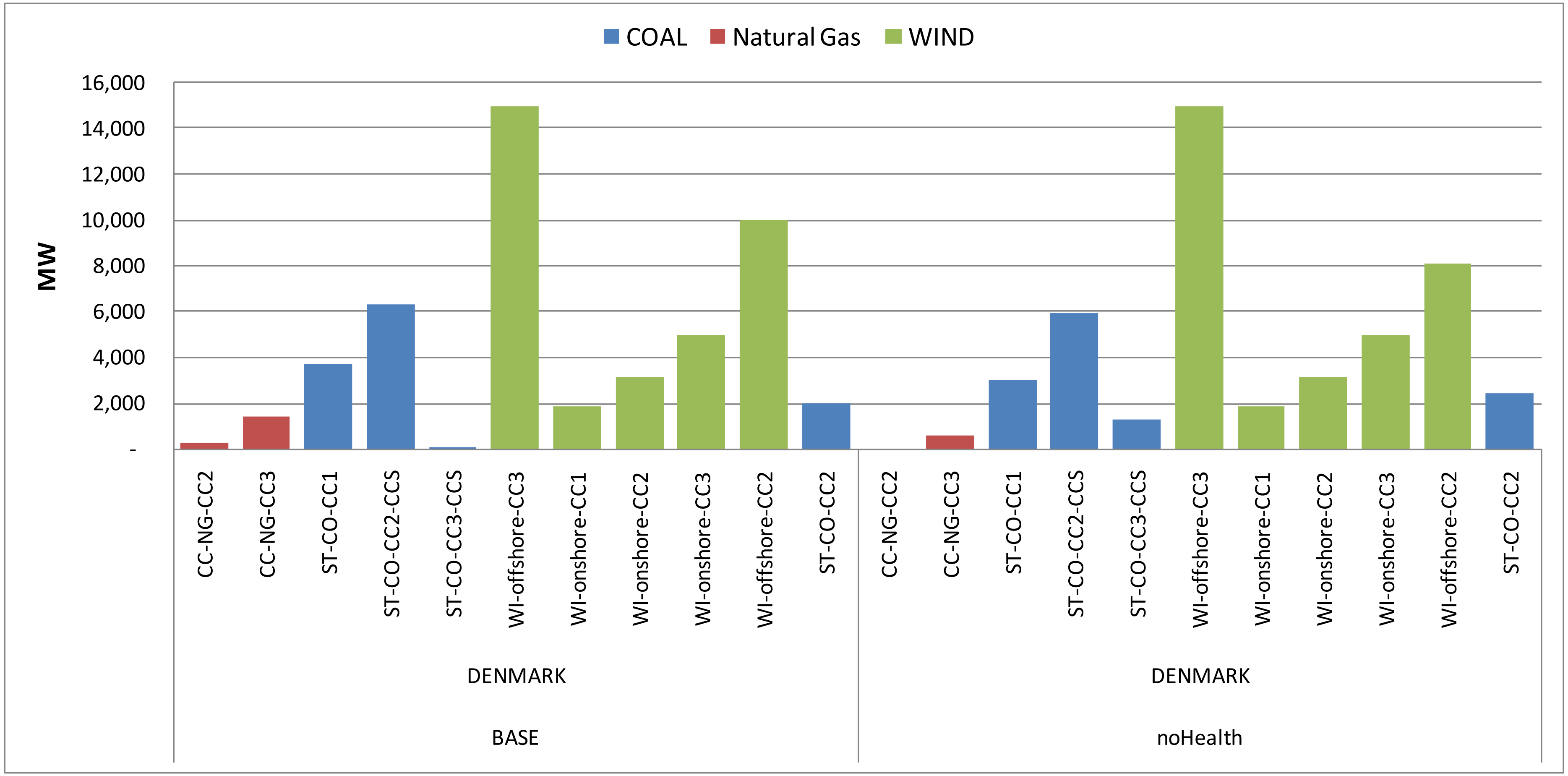
Technology Competiveness: Electricity



Heat saving potential (Ref.: Erika Zvingilaite, Risø DTU)



New power capacity in Denmark until 2050



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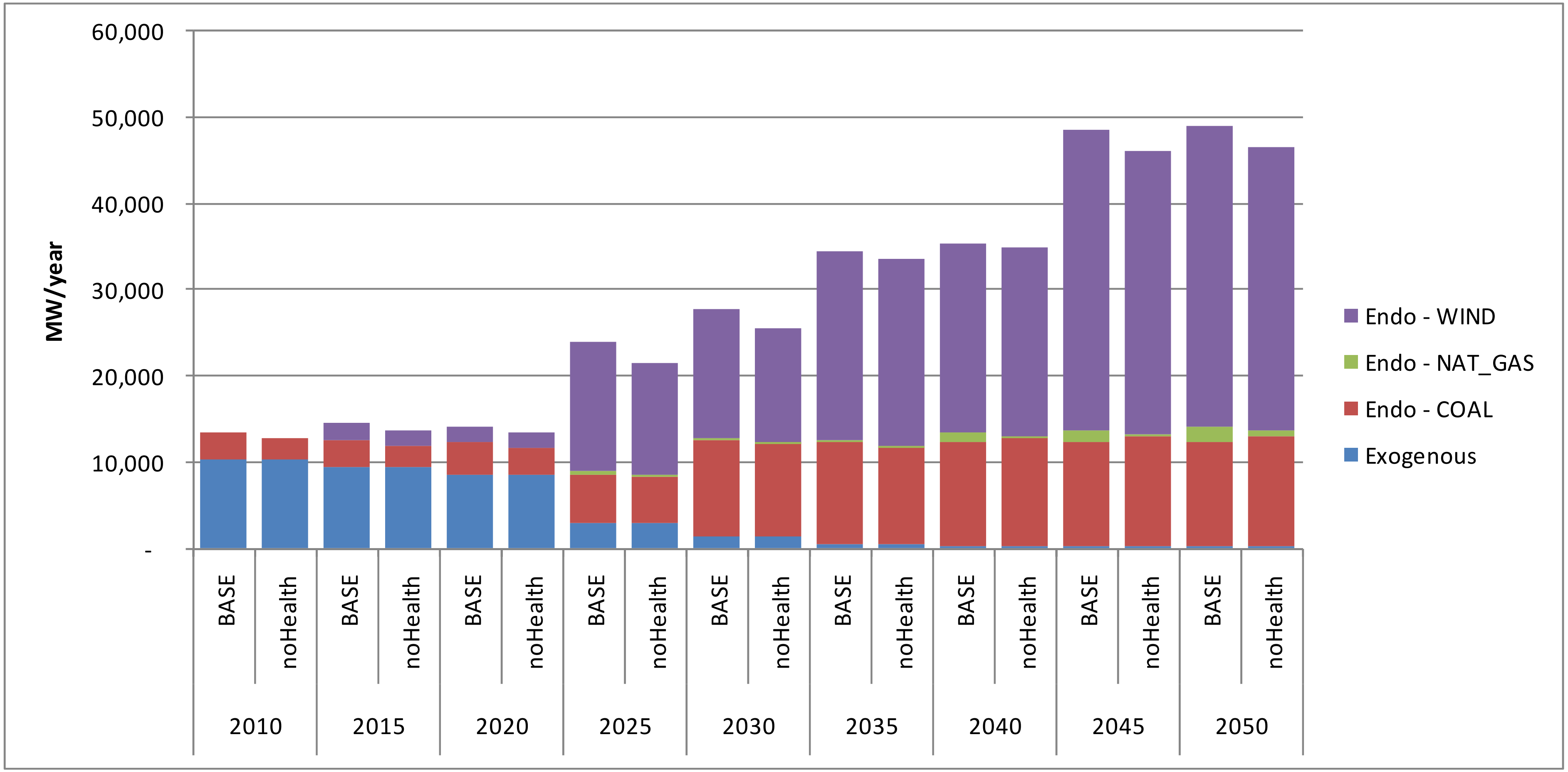
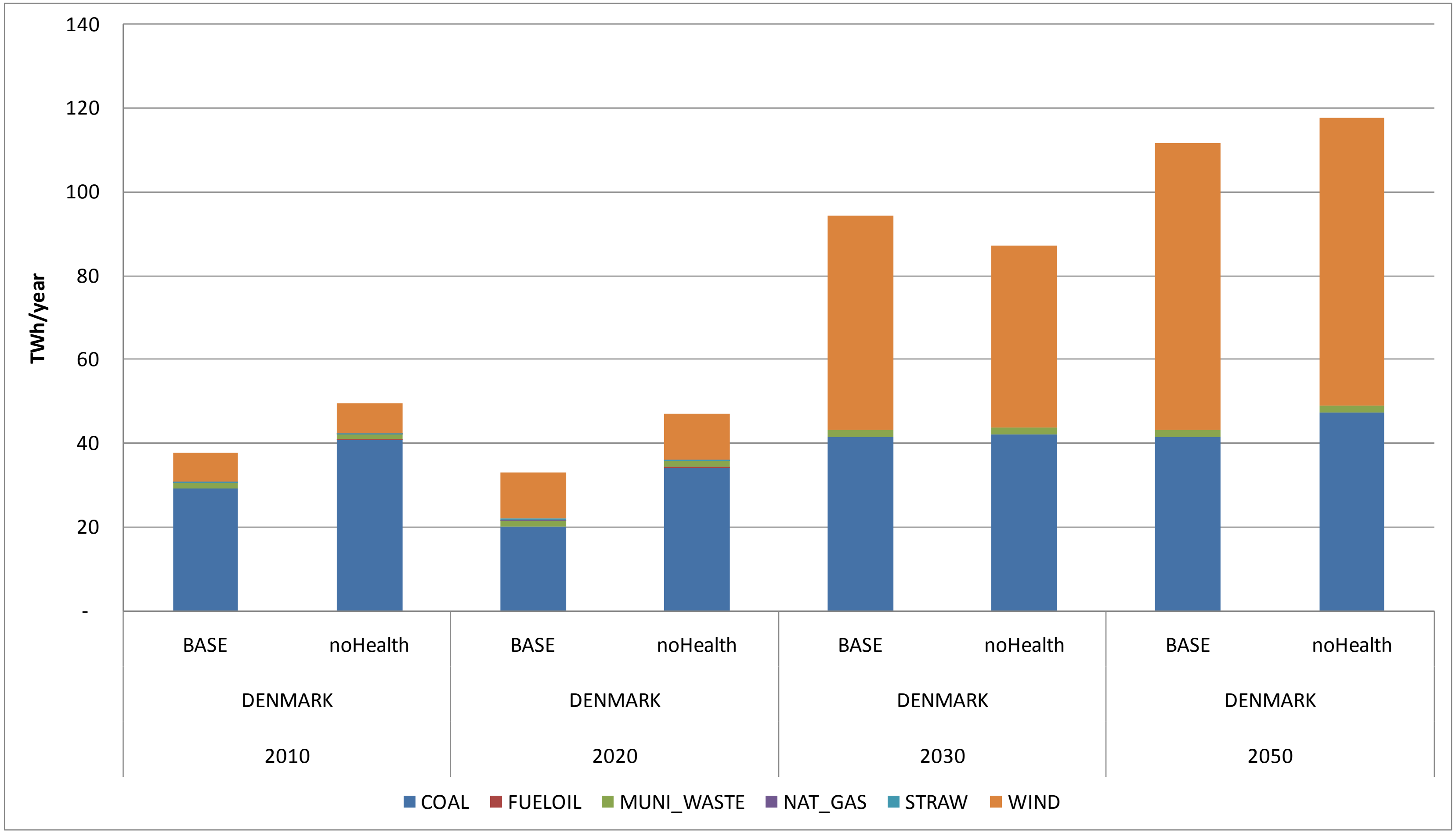
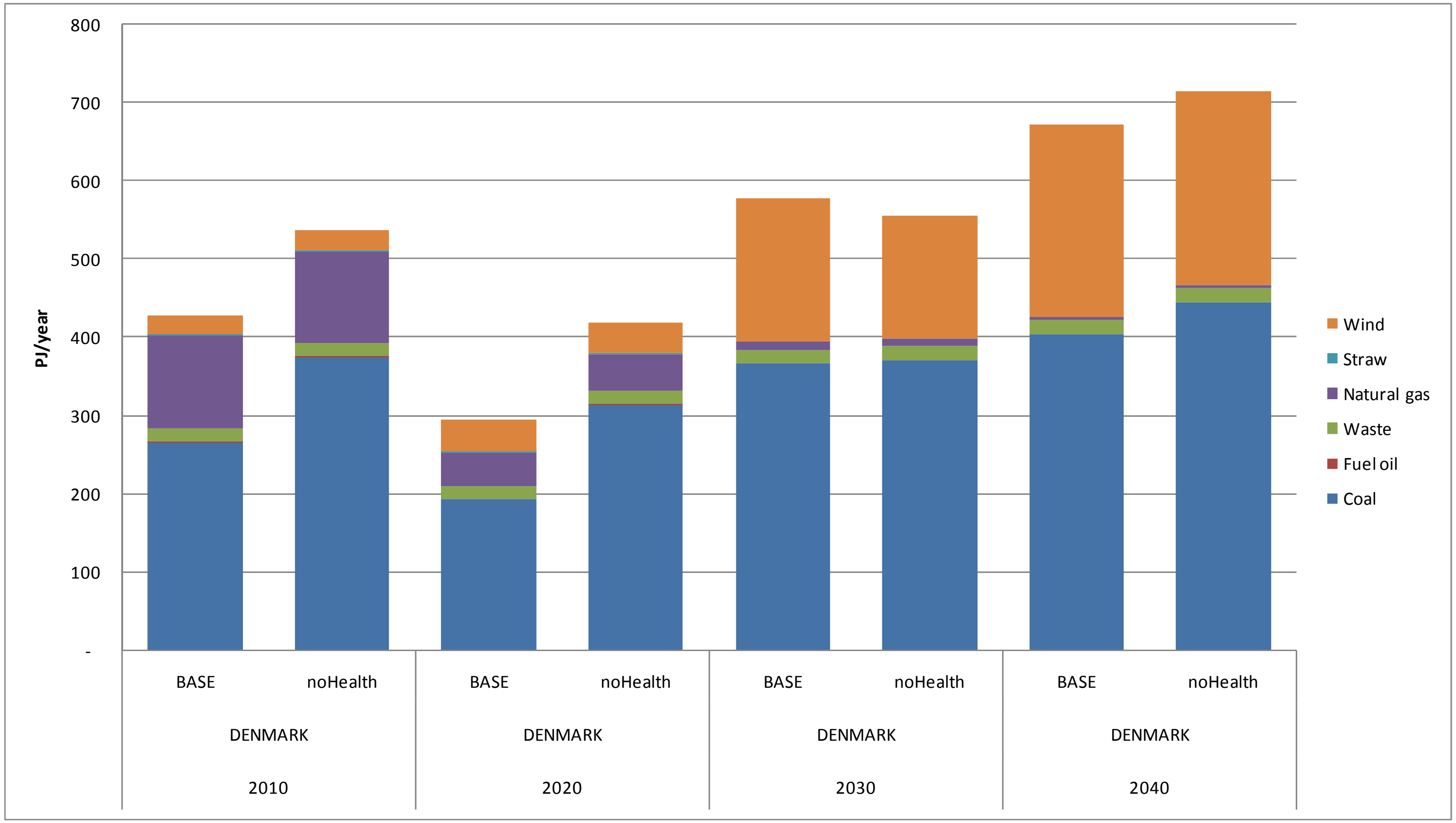
Power capacity in Denmark



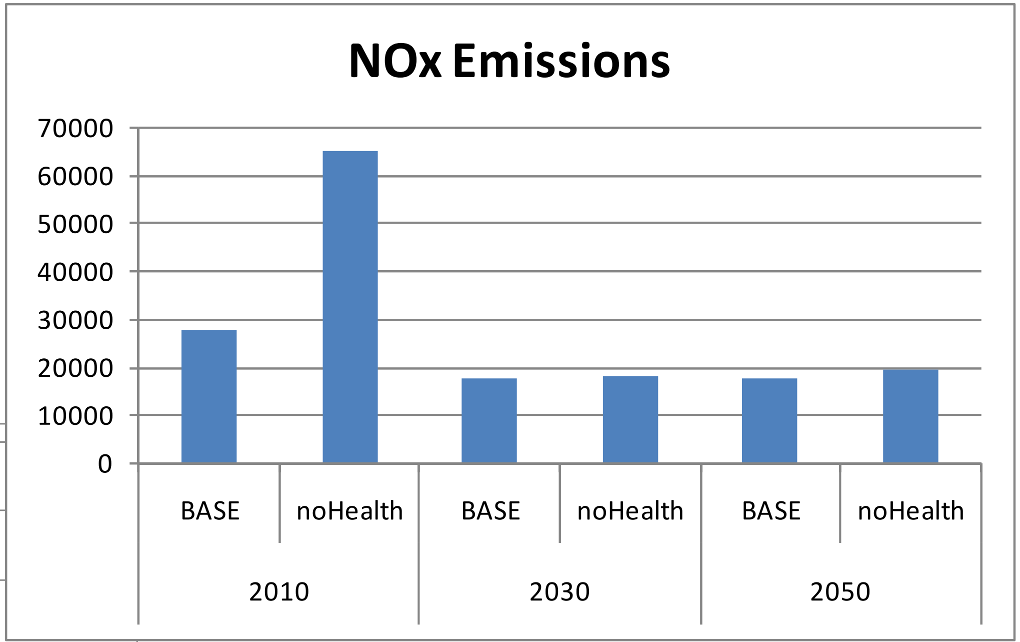
Electricity production in Denmark

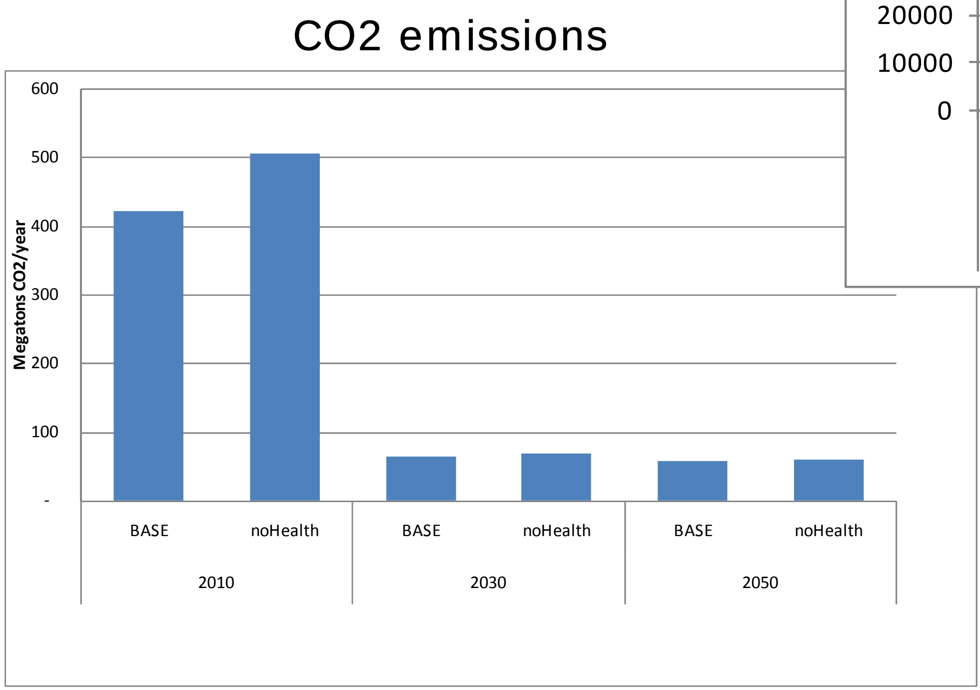


Total fuel consumption in the power sector in Denmark



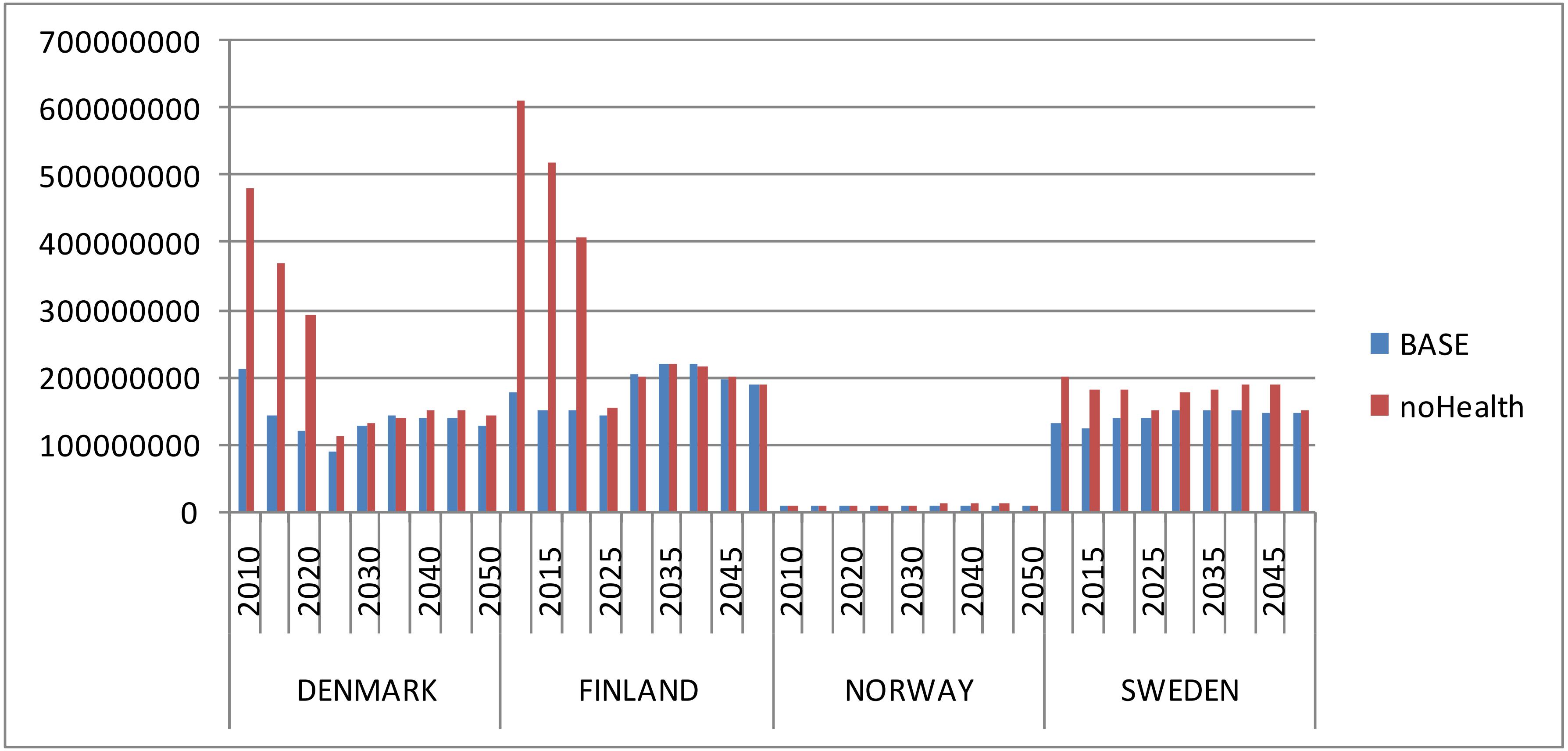
Emissions

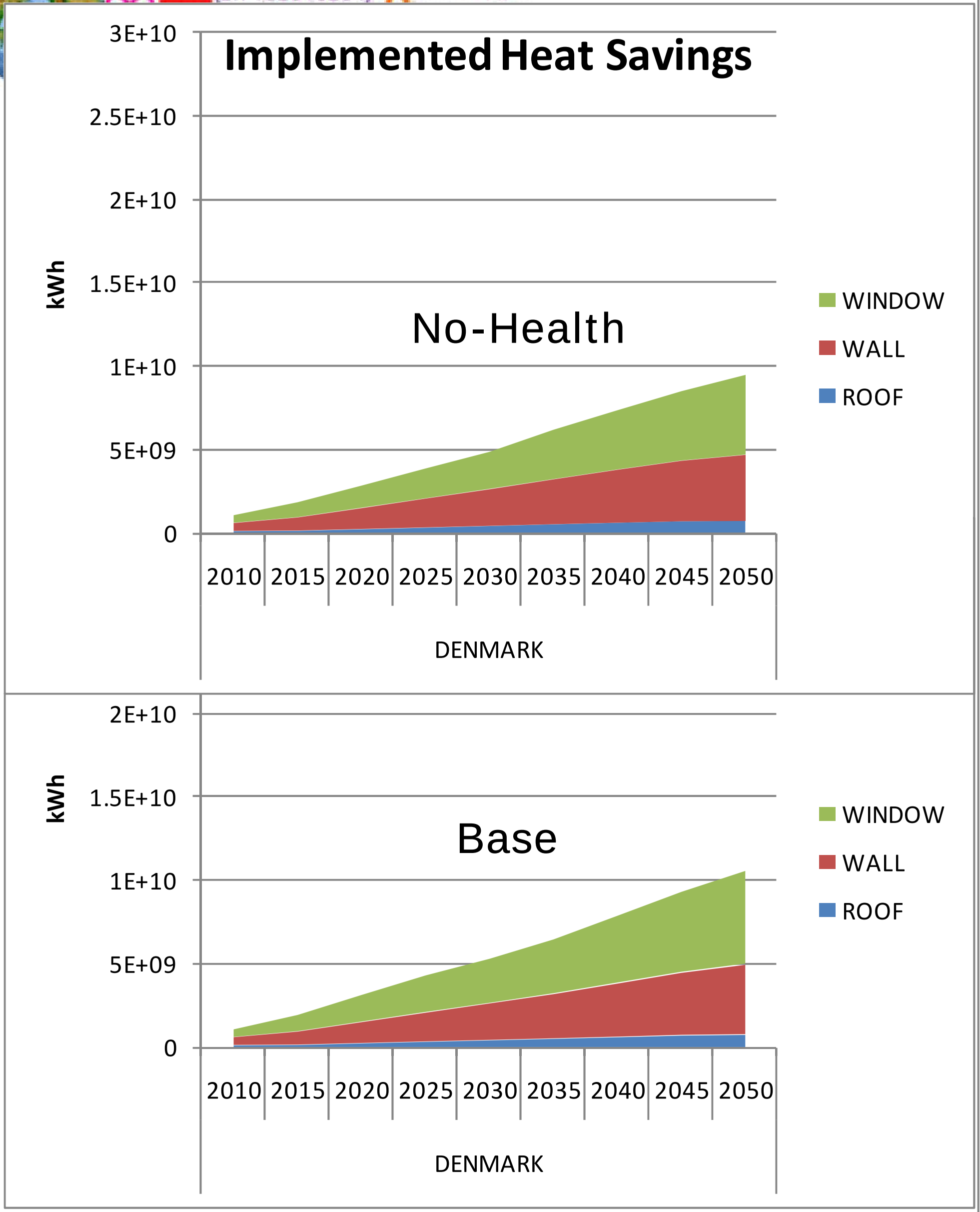

NOx Emissions
70000
60000
50000
40000
30000
20000
10000
0
BASE
noHealth
BASE
noHealth
BASE
noHealth
2010
2030
2050

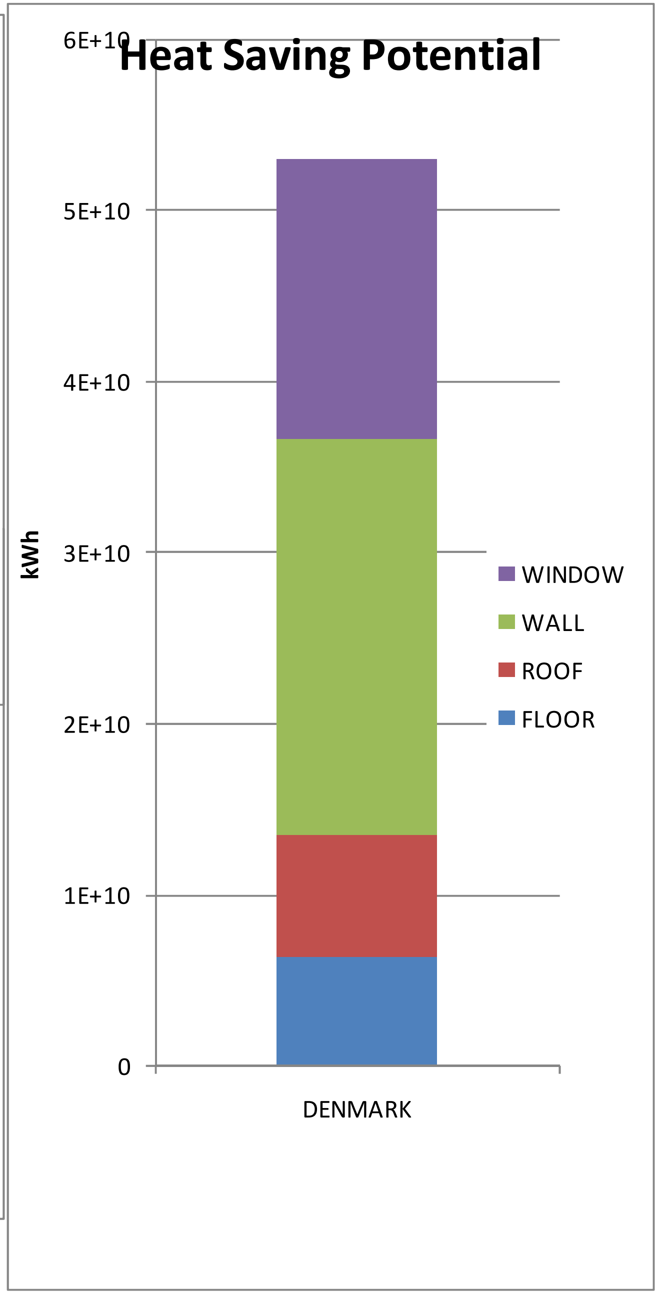

CO2 emissions
Megatons CO2/year
600
500
400
300
200
100
-
BASE
noHealth
BASE
noHealth
BASE
noHealth
2010
2030
2050

Health costs of Nox emissions

Mio. €/year

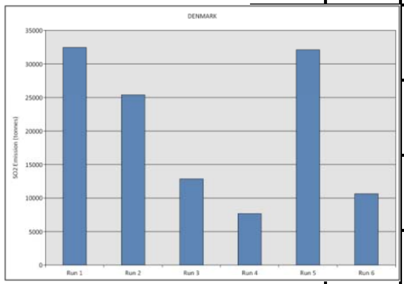



Implemented Heat Savings
No-Health
kWh
3E+10
2.5E+10
2E+10
1.5E+10
1E+10
5E+09
0
2010 2015 2020 2025 2030 2035 2040 2045 2050
DENMARK
WINDOW
WALL
ROOF
Base
kWh
2E+10
1.5E+10
1E+10
5E+09
0
2010 2015 2020 2025 2030 2035 2040 2045 2050
DENMARK
WINDOW
WALL
ROOF

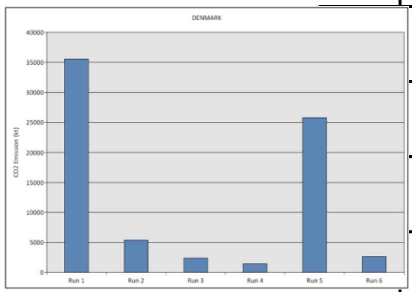

Heat Saving Potential
kWh
6E+10
5E+10
4E+10
3E+10
2E+10
1E+10
0
DENMARK
WINDOW
WALL
ROOF
FLOOR

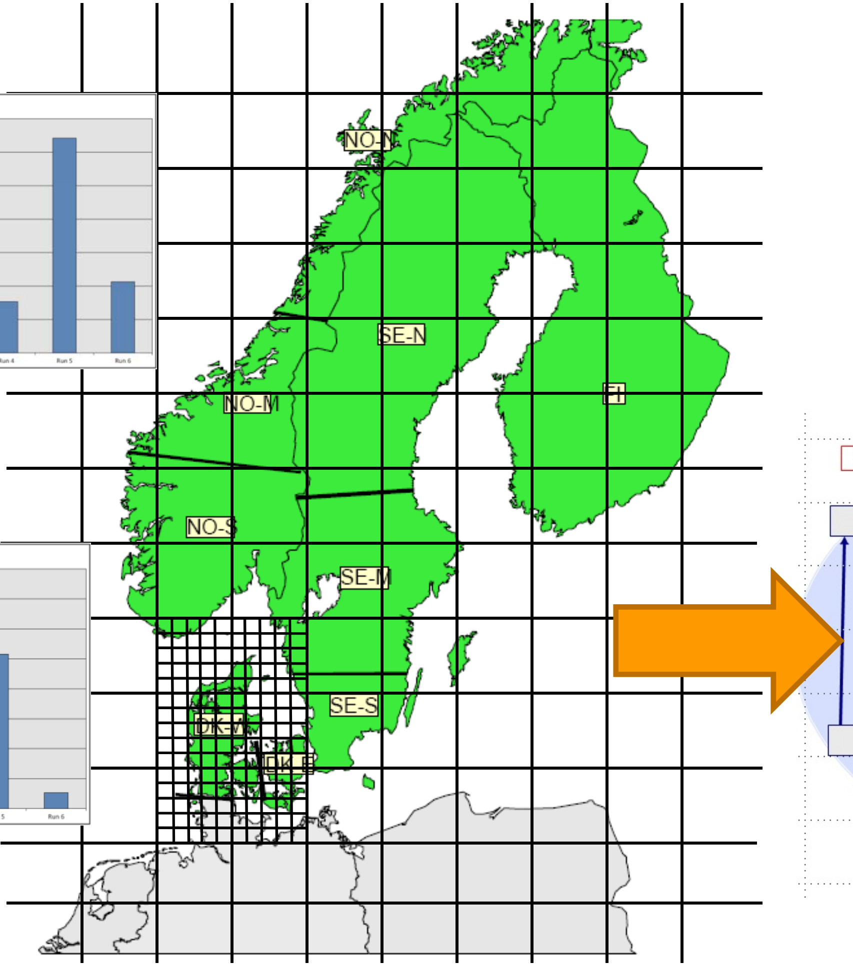
Returning revised emissions to the air emission model

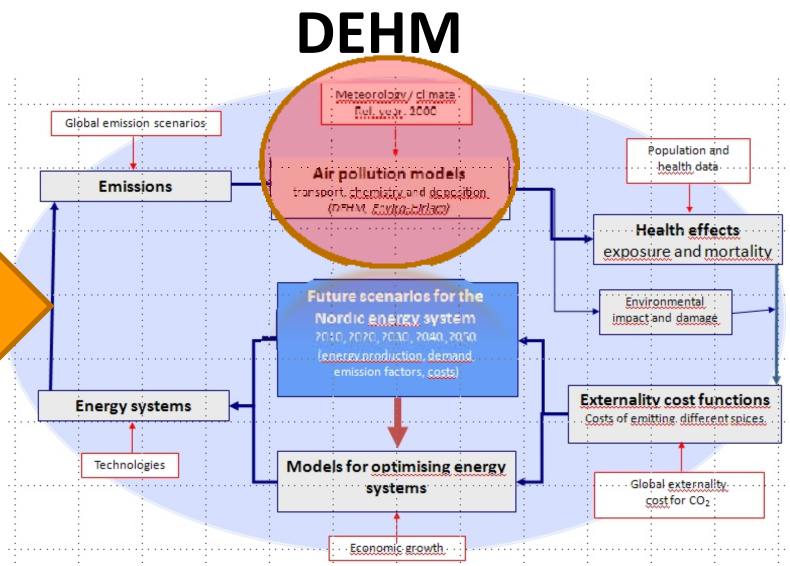
Emissions



Emissions







THANK YOU FOR YOUR ATTENTION AND AN INTERESTING CONFERENCE!

Centre of Energy, Environment and Health

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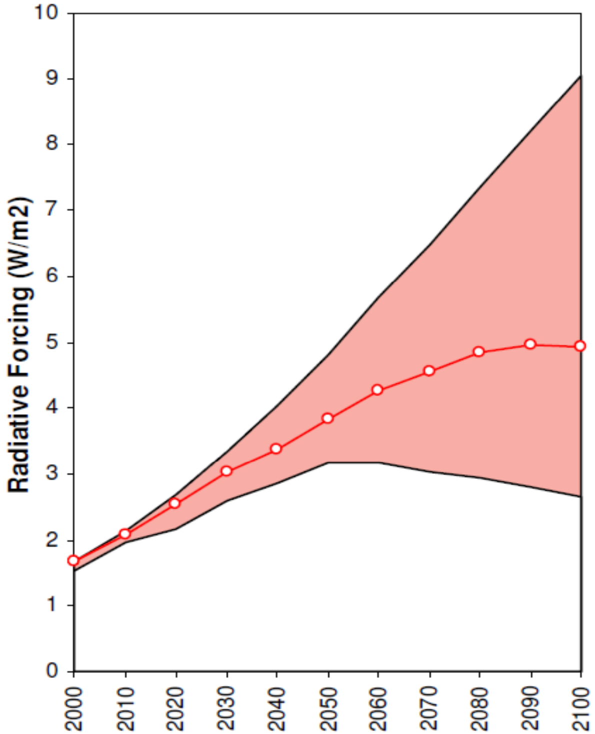
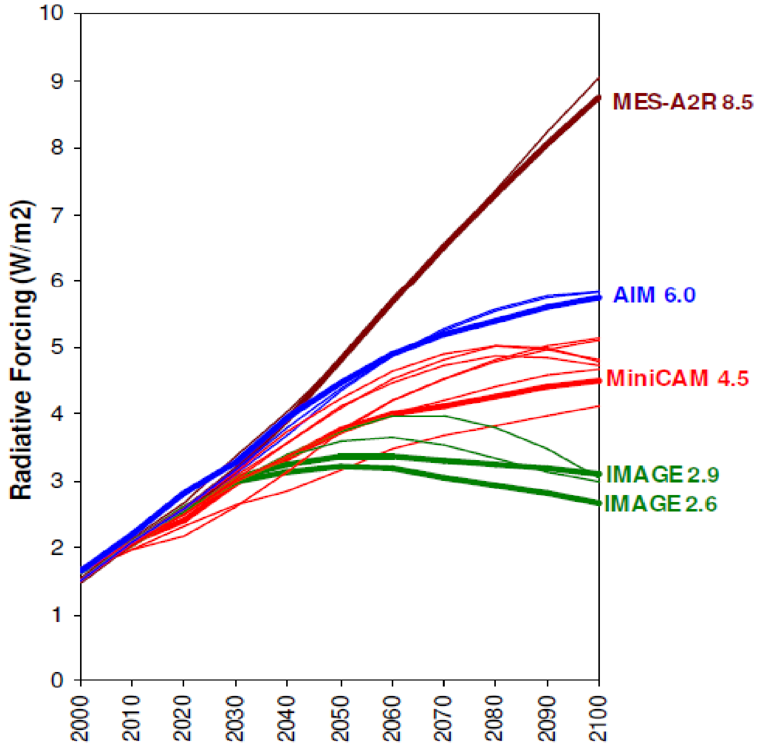
DTU Climate Centre:
http://www.dtu.dk/centre/klimacenter/english

Four RCP IPPC Scenarios





Name	Radiative Forcing	Concentration	Pathways Shape
RCP8.5	8.5W/m^2 (in 2100)	<= ~1370 CO_2-eq	Rising
RCP6.0	~6.0W/m^2 (stabilization after 2100)	~850 CO_2-eq	Stabilization without overshoot
RCP4.5	~4.5W/m^2 (stabilization after 2100)	~650 CO_2-eq	Stabilization without overshoot
RCP3-PD	< 3W/m^2 (peak and decline) ⇒ 2.6W/m^2	< ~490 CO_2-eq	Peak & decline